

COLUMN 14 CONTINUED

s claimed is:

1. A single integrated graphics and video controller adapted for driving a display sequentially comprising:
 - an interface for receiving words of pixel data, each said word associated with an address buffer;
 - 10 circuitry for writing each said word of said pixel data received by said interface to a one of on-screen and off-screen memory areas of a frame buffer;
 - circuitry for selectively retrieving as data is provided for display, said words from said on-screen and off-screen areas;
 - 15 a first pipeline for substantially continuously processing words of graphics data retrieved from said frame buffer; and
 - a second pipeline for processing words of video data retrieved from said frame buffer so that the video data is ready for display once a display raster scan reaches a display position of a window.
2. The controller of claim 1 and further comprising output selection circuitry for selecting for output between graphics data received from said first pipeline and data received from said second pipeline, said selection circuitry operable to:
 - in a first mode, pass data from said [first pipeline:] first pipeline; and
 - 25 in a second mode, pass data from said second pipeline when said data corresponds to a selected display position of a display window.
3. The controller of claim 2 wherein said selection circuitry is further operable to:
 - 30 in a third mode, pass data from said second pipeline when said data corresponds to said selected display position of said display window and data from said first pipeline match a color key.
 4. The controller of claim 3 wherein said selection circuitry is further operable in a fourth mode to pass data from said second pipeline when data from said first pipeline match a color key.
 5. The controller of claim 1 wherein said circuitry for retrieving maintains a stream of graphics data to said first pipeline and provides video data to said second pipeline when a display raster scan reaches [said display] a display [said window] a window. position of
 6. The controller of claim 1 and further comprising:
 - a video port for receiving real-time video data; and
 - 45 circuitry for generating an address to said memory at which said real-time video data is to be stored.
 7. The controller of claim 1 wherein said second pipeline includes a first first-in-first-out memory for receiving data for a first display line of pixels in memory and a second first-in-first-out memory for receiving data from a second display line of [pixels memory] pixels in memory.
 - 50 8. The controller of claim 7 wherein said first display [line adjacent] line is adjacent in memory to said second display line.
 9. The controller of claim 7 further comprising output selection circuitry wherein said output selection circuitry comprises:
 - 55 an output selector for selecting between data from said second pipeline and data from said first pipeline in response to a selection control signal;
 - 60 a register for maintaining a plurality of overlay control bits;
 - window position control circuitry for selectively generating a position control signal when a word of said data stream from said second pipeline falls within a display window;
 - 65 color comparison circuitry for comparing words of said data stream from said first pipeline with a color key and

for providing in response a color comparison control signal; and
a control selector for selectively providing [a] said

selection
control signal in response to said overlay control bits in
said register and at least one of said position control and 5
color comparison control signals.

10. The controller of claim 9 wherein said window position control circuitry comprises:

window position counters operable to increment from initial count values corresponding to a starting pixel of 10
a display window as data representing each pixel in a display screen is pipelined through said overlay control circuitry;

screen position counters operable to count as data representing each pixel in said display screen is pipelined 15 through said overlay control circuitry; and

comparison circuitry operable to compare a current count in said window position counters and a current count in said screen position counters and selectively generate 20 said position control signal in response.

11. The controller of claim 9 wherein said color comparison circuitry comprises:

a color key register for storing bits composing said color key; and

a plurality of AND-gates for comparing said words of said 25 graphics data stream with bits of said color key.

12. The controller of claim 1 wherein said interface includes a dual-aperture port.

13. A single integrated controller comprising:
circuitry for writing selectively, on a word by word basis,
each word of received 30

data into [s] a

selected one of on-screen and off-screen memory spaces of a frame buffer;

a first port for receiving video and graphics data, a word of said data received with an address of said memory 35 spaces directing said word to be processed as a word of video data or a word of graphics data;

a second port for receiving real-time video data;
circuitry for generating an address associated with a selected one of said memory spaces for a word of said 40 real-time video data;

circuitry for selectively retrieving said words of data on a word by word basis from said on-screen and off-screen memory spaces as data is rastered for driving a display in a sequential fashion;

a graphics backend pipeline for processing ones of said 45 words of data representing graphics data retrieved from said frame buffer;

a video backend pipeline, separate

from said graphics backend pipeline,
for processing other ones of said words of data representing video data retrieved from 50 said frame buffer, said circuitry for retrieving always rastering a stream of data from said frame buffer to said graphics backend pipeline and rastering video data to said video backend pipeline [when] so that the video data is ready for display once

a display raster scan reaches a display position of a window; and

output selector circuitry for selecting for output between words of data output from said graphics backend pipeline and words of data output from said video backend pipeline.

14. The controller of claim 13 wherein said output selector circuitry

is further operable to select between graphics data output from a color look-up table and true color data output from said graphics pipeline.

15. The controller of claim 13 wherein said output selector circuitry

is operable to:
in a first mode, pass only a word of data output from said 65 graphics pipeline;

in a second mode, pass a word of data output from said video pipeline when said display raster scan has reached a display position corresponding to a window and a word of data from said graphics pipeline when said display raster scan is in any other display position;

5 in a third mode, pass a word of data output from said video pipeline when said display raster scan has reached a display position corresponding to a window and a corresponding word of data from said graphics pipeline matches a color key and a word of data from said graphics pipeline when said display raster scan is in any other display position; and

10 in a fourth mode, pass a word of data from said video pipeline when said corresponding word of data from said graphics pipeline matches a color key and a word of data from said graphics pipeline when said [display raster scan is in any other display position] corresponding word does not match said color key.

15 16. The controller of claim 13 wherein said video pipeline includes a first first-in-first-out memory for receiving a plurality of words of data for a first display line of pixels in memory and a second first-in-first-out memory [or] for receiving

20 a plurality of words of data [from] for a second display line of pixels in memory.

25 17. The controller of claim 16 wherein said first display line is stored adjacent in memory to said second display line.

18. The controller of claim 13 wherein said output selector circuitry comprises:

30 a control selector having a plurality of control inputs coupled to a register, said register storing a plurality of overlay control bits;

35 window position control circuitry coupled to a first control input of said control selector, said window position control circuitry operable to selectively provide a first control signal to said first control input when a word of data being pipelined through said video pipeline falls within a display window;

40 color comparison circuitry operable to compare a word of data being pipelined through said graphics pipeline with a color key and provide in response a second control signal to a second control input of said control selector; and

45 wherein said control selector is operable to provide an output selection control signal in response to at least one of said first and second control signals and said overlay control bits being stored in said register.

19. The circuitry of claim 18 wherein said output selector circuitry further includes a third control input coupled to certain bits of said graphics pipeline, said output selector circuitry further

50 operable to select between data on said respective video and graphics pipelines in response to said certain bits presented to said selector circuitry.

20. The circuitry of claim 18 wherein said window position control circuitry comprises:

55 a window x-position counter operable to count from a loaded x-position value in response to a video clock, said x-position counter reloading in response to a display horizontal synchronization signal;

60 a window y-position counter operable to count from a loaded y-position value in response to said horizontal synchronization signal, said y-position counter reloading in response to a display vertical synchronization signal;

65 CRT position circuitry operable to maintain counts corresponding to a current display pixel; and comparison circuitry operable to compare current counts in said window counters with said current counts held

in said CRT position circuitry and generate in response
said first control signal.

21. The circuitry of claim 20 wherein said window
position control circuitry further comprises an x-position
register for holding said x-position value for loading into
said x-position counter and a y-position register for holding
said y-position value for loading into said y-position
counter. 5

22. The circuitry of claim 13 wherein said color compari-
son circuitry comprises:

a color key register for storing a plurality of color key bits;
and 10

a plurality of XNOR-gates each having at least one input
coupled to a bit position in said color key register and
at least one input coupled to said graphics data path. 15

23. The circuitry of claim 13 wherein said video pipeline
comprises:

a first-in/first-out memory for receiving a first stream of
words of data from said frame buffer;

a second first-in/first-out memory disposed in parallel 20
with said first first-in/first-out memory for receiving a
second stream of words of data from said frame buffer;
and

interpolation circuitry for selectively generating an addi-
tional word of data by interpolating a word of said first 25
stream and a word of **said second**

stream data output from
said first and second first-in/first-out memories.

24. The controller of claim 13 wherein said first [pore] port
comprises a dual-aperture port.

25. A display system comprising:

a first backend pipeline for processing data;

a second backend pipeline for processing graphics data
disposed in parallel to said first processing pipeline;

a multi-format frame buffer memory having on-screen
and off-screen areas each operable to

to allow said frame buffer to

simultaneously 35
store data in graphics and video formats;

[a] an

input port for receiving both graphics and video data,
each word of said data associated with an address
directing said word to be processed as either graphics 40
or video data;

circuitry for writing a word of said playback data into a
selected one of said areas of said multi-format memory;

memory control circuitry for controlling the transfer of
data between said first backend pipeline and said frame 45
buffer and between said second backend pipeline and
said frame buffer;

a display unit; and

overlay control circuitry for selecting for output to said
display unit between data provided by said first back-
end pipeline and data provided by said second back-
end pipeline. 50

26. The display system of claim 25 wherein said second
backend pipeline includes:

a first first-in-first-out memory for receiving first selected
data;

a second first-in-first-out memory disposed in parallel to
said first first-in-first-out memory for receiving second
selected data; and 55

interpolation data for generating additional data by inter-
polating data output from said respective first and
second first-in-first-out memories.

27. The display system of claim 26 wherein said second
backend pipeline further comprises color conversion cir- 65
cuitry for converting data received from said frame buffer in
a video format to a graphics format.

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28. The display system of claim 25 [and]

further comprising
a video front-end pipeline for inputting video data into a selected one of on-screen and off-screen spaces of said frame buffer comprising:

- 5 a video data port for receiving video data from a real time data **source; and**
- 10 input control circuitry for receiving framing signals associated with said real time data and generating corresponding addresses to said selected one of said spaces in response.
- 15 29. The display system of claim 28 wherein said video front-end pipeline further comprises encoding circuitry for packing said video data prior to storage in said selected one of said spaces.
- 20 30. The display system of claim 28 wherein said video front-end pipeline further [comprising] comprises multiplexing circuitry for selecting between video data received through said video data port and data received from [said] a dual aperture port.
- 25 31. The display system of claim 30 wherein said video front end pipeline further comprises conversion circuitry for converting graphics data received through said dual-aperture port to a video format for storage in said selected one of said spaces.
- 30 32. The display system of claim 25 wherein said first backend pipeline processes playback video.
- 35 33. The display system of claim 25 wherein said input port comprises a dual-aperture input port.
- 40 34. A single integrated display data processing system comprising:
circuity for writing data into an on-screen space of a frame buffer;
circuity for writing data into an off-screen space of said frame buffer;
a video pipeline for processing data output from a selected one of said on-screen and off-screen spaces comprising:
a first first-in-first-out memory for receiving selected data from said selected space;
a second first-in-first-out memory disposed in parallel to said first first-in-first-out memory for receiving other selected data from said selected space; and
an interpolator for generating additional data by interpolating data output from said respective first and second first-in-first-out memories;
- 45 35. A graphics pipeline disposed in parallel to and separate from said video pipeline for processing data output from a selected one of said on-screen and off-screen spaces; and
an output selector for selecting between data output from said video pipeline and data output from said graphics pipeline.

COLUMN 18 CONTINUED

35. The system of claim 34 [and]

50 further comprising
selection control circuitry for generating an output control
signal for controlling said output selector comprising:

a control selector having a plurality of data inputs coupled
to a register, said register for storing a plurality of
overlay control bits; and

55 color comparison circuitry operable to compare bits of
data output from said graphics pipeline with a color key
and provide in response a control signal to a control
input of said control selector.

36. The system of claim 34 [and] further comprising
60 window position control circuitry operable to provide a
second control signal to a second control input of said
control selector when data from said video pipeline falls
within a display window.

37. A single integrated
display controller comprising:
65 circuitry for selectively retrieving data from an associated
multi-format frame buffer, the frame buffer having
separate storage locations respectively operable for allowing
for simultaneously
[snoring] storing
graphics and video data;
in, said frame buffer;

a first pipeline for processing words of graphics data selectively retrieved from said frame buffer; and
a second pipeline, separate from the first pipeline,

for processing words of video data selectively retrieved from said frame buffer.

38. The controller of claim 37 wherein said first and 5 second pipelines are disposed in parallel and concurrently process data.

39. The controller of claim 38 [and]

further comprising output selection circuitry for selecting for output between graphics data received from said first pipeline and video data 10 received from said second pipeline.

40. The controller of claim 37 wherein said frame buffer is partitioned into on-screen and off-screen areas, each of said on-screen and off-screen areas operable to allow the buffer to

simulta-

neously store both graphics and video data. 15
41. The controller of claim 37 wherein said circuitry for selectively retrieving is operable to retrieve a substantially

constant stream of graphics data from said frame buffer and provide said stream of graphics data to said first pipeline.

42. The controller of claim 41 wherein said circuitry for 20 selectively retrieving is operable to retrieve at least one said word of video data from said frame buffer and provide said at least one word of said video data to said second pipeline, only when said display controller is generating a video 25 display window.

43. A display controller for interfacing a multi-format frame buffer and a display device, the multi-format frame buffer having on-screen and off-screen areas each operable for allowing simultaneously storing both graphics and video pixel data in the frame buffer,

said 30

display controller comprising:
circuitry for selectively retrieving pixel data from a selected one of said on-screen and off-screen areas of said frame buffer;

a graphics backend pipeline for processing graphics data 35 retrieved from said selected one of said areas of said frame buffer;

a video backend pipeline for processing video data retrieved from said selected one of said areas of said frame buffer; and

5 an output selector for selectively passing to said display device data received from said graphics or video backend pipelines.

44. The display controller of claim 43 wherein said circuitry for selectively retrieving is operable to retrieve at least one said word of video data from said frame buffer and provide said at least one said word of video data [no] to

10 said second pipeline only when said display controller is generating a video display window.

15 45. The display controller of claim 43 wherein said output selector is operable to:

in a first [modes] mode

pass data from said graphics pipeline; and

in a second [modes] mode

20 pass data from said video pipeline when a display position corresponding to a video display window has been reached.

46. The display window of claim 43 wherein said output selector is operable to:

in a first mode, pass data from said graphics pipeline; and

25 in a second mode, pass data from said video pipeline when a display position corresponding to a video display window has been reached and data from said graphics pipeline match a color key.

47. The display controller of claim 43 wherein said output selector is operable to:

in a first mode, pass data from said graphics pipeline; and

in a second mode, pass data from said video pipeline when data from said graphics pipeline matches a color key.

35 48. The controller of claim 42 in which graphics data is substantially continuously retrieved for a display while video data is retrieved only for the video display window.

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